S/685/61/000/000/001/004
D205/D301

Peculiarities of phase ...

content of all alloys was 0.07 %. In the range 5.9 - 9.57 % Ni steels ranging from austenitic-martensitic have been prepared. δ-ferrite was revealed in both groups, its amount in the first group being somewhat higher. In every group, however, the amount of δ-ferrite varied from alloy to alloy. After smelting, the specimens were forged to rods of 7 - 8 mm radius, quenched from 1050°C and annealed for 3 hours at 750°C. The obtained state was considered as the starting structure. The kinetic and the quantitative relations of the phase changes were investigated by the magnetic method. The microstructure and hardness of the alloys were also measured. Hysteresis loops of the $\gamma \rightarrow \alpha$ and $\alpha \rightarrow \gamma$ transformations in the +700 to -78°C temperature range are given. From these loops the temperatures of the martensitic transformations were determined. It was found that alloys containing 15 % Cr and 7.75 % Ni preserve their austenitic structure down to -78°C. If the Cr content is lowered to 12.5 %, the Ni content is to be increased to 9.5 % in order to ensure the stable austenitic state. The thermal history preceding the cooling-heating cycle of the hysteresis loop has a large influence on the loop itself. The increase of the pre-heating tem-

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D205/D301

Peculiarities of phase ...

perature from 850 to 1050°C causes the dissolution of the secondary phases and thus the solid-solution is enriched by alloying elements and its stability increases, the martensitic transformations being prevented. Prolonged pre-heatings at high temperatures cause separation of the excess of the alloying elements from the austenite and the decomposition of the δ-ferrites into γ' and carbides, enhancing the martensitic transformations during the hysteresis cycle. A complex secondary thermal treatment in which the $\gamma \rightarrow \alpha$ and $\alpha \rightarrow \gamma$ transformations take place enhances the martensitic transformations during the hysteresis cycle. The quantitative data on the influence of pre-heating temperature and the final cooling temperature on the phase composition and hardness of the alloys (Vickers degrees) are given for alloys of the I and II groups. The influence of annealing for 1 hour in the 300 - 700°C range was investigated. The annealing strengthens the alloys, but the exact character of this depends again on the previous history of the alloy. If the alloy did previously undergo a martensitic transformation, the highest strengthening occurs below 500°C, otherwise the strengthening occurs at 650 - 750°C and is quantitatively lower than in the first case. The influence of ageing performed at temperatures from 400 to

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750°C for up to 36 hours was also studied. Again, the hardening during ageing depends upon the annealing. There are 21 figures, 6 tables and 22 references: 11 Soviet-bloc and 11 non-Soviet-bloc. The 4 most recent references to the English-language publications read as follows: Gibraith, Austral. Machinery, 11, 1958, 117, 23-31; Iron Age, 181, 1958, 22, 88-89; White, Metal Progr., 73, 1958, 6, 74-78; West, Metals, 15, 1957, 10, 62.

S/685/61/000/000/002/004
D205/D301

AUTHORS: Prosvirin, V. I., and Tarasov, B. Ya.

TITLE: Nitriding using high-frequency heating currents

SOURCE: Akademiya nauk Latviyskoy SSR. Institut avtomatiki i mekhaniki. Prevrashcheniya v splavakh i vzaimodeystviye faz. Riga, 1961, 51 - 87

TEXT: The nitriding of steel 38ХМЮА (38KhMYuA) is usually performed at 500 - 600°C for a prolonged time (days). It appeared, however, feasible to shorten considerably these long treatments by employing simultaneous nitriding and hardening. The metastable structures formed during nitriding, having a high hardness, could be preserved by quenching. Thus, investigations directed towards determining conditions using higher than usual temperatures and much shorter times (2 - 10 min) were justified. The nitriding apparatus is described and illustrated. Two processes were tried: (1) At constant temperature; (2) At a cyclically changing temperature (between constant limits). The following materials were investigated: Armco iron (C-0.04 %), Steel 45Х (45Kh), Steel 38KhMYuA (C -
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S/685/61/000/000/002/004
D205/D301

Nitriding using high-frequency ...

0.35 %, Cr - 1.54 %, Al - 0.63 %, Mo - 0.16 %) and perlitic cast iron. Tubular, cylindrical and ring shaped specimens were employed. As the nitriding is performed by N_2 formed during thermal dissociation of ammonia, the degree of dissociation of NH_3 as a function of the temperature and flow velocity was investigated under the conditions of HFC heating. It was found that the maximum absorption in iron takes place at 815 - 910°C and in steel at 860°C. With increasing temperature the optimum flow velocity of NH_3 is shifted towards higher values. Iron absorbs 3 - 6 times more N_2 than 45Kh steel in the 800 - 1000°C range. The short-time nitriding produces at 910°C for iron and 860°C for 45Kh steel a visible diffusion layer consisting of an external zone of rod-like crystals (ε-phase) and an internal zone of nitrided austenite and nitrided martensite. Above 1020°C for iron and above 900°C for 45Kh steel the diffusion layers were homogeneous. The 2 minute nitriding of iron gives diffusion layers 0.05 - 0.09 mm thick, having a surface of 400 - 600 kg/mm². The corresponding figure for the 45Kh steel is 1500 kg/mm². Nitriding of the 38KhMYuA steel was best performed at 750°C for 10 mins. The diffusion layer obtained was 0.12 mm thick having a hardness of

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Nitriding using high-frequency ... S/685/61/000/000/002/004
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615 kg/mm^2. However, this could be markedly improved by annealing. Annealing for 1 hour at 500°C produced a surface hardness of 1100 - 1200 kg/mm^2. Short-time nitriding followed by quenching causes a sharp increase in the surface hardness of perlitic cast-iron. There are 19 figures, 3 tables and 22 Soviet-bloc references.

Card 3/3

33733
S/685/61/000/000/003/004
D205/D301

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AUTHORS: Prosvirin, V.I., and Nesgovorov, L.Ya.

TITLE: Corrosive-erosive destruction of iron in a gas stream

SOURCE: Akademiya nauk Latviyskoy SSR. Institut avtomatiki i mekhaniki. Prevrashcheniya v splavakh i vzaimodeyst- viye faz. Riga, 1961, 117 - 150

TEXT: In this investigation the scheme "hot specimen - cold air" was chosen which enabled the heating of the metal sample up to its melting point. The apparatus employed is illustrated and described. The specimen was electrically heated by a current of 50 c/s, 70 - 450 amp. The appratus was equipped with interchangeable nozzles calculated for 1.5, 2.0, 2.5, 3.0, 3.5, 4.0 Mach numbers. The specimens could be placed at every multiple angle of 15° with respect to the gas stream. Armco iron samples were chosen, their shape being shown in Fig. 2, measuring the extent of destruction by weight losses related to the exposed surface. Plots of weight loss per unit of surface were constructed as functions of temperature and Mach number. The rate of the erosive-corrosive destruction of

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D205/D301

Corrosive-erosive destruction of ...

iron was investigated in the 0 - 4 Mach number and 800 - 1000°C ranges. A new phenomenon of the corrosive-erosive destruction of iron in an air stream was revealed. Thus in the subsonic range (up to $M \leq 0.8$) the destruction rate is increased with gas velocity, in the range $1 \leq M \leq 1.7 - 1.8$ the rate of destruction decreased with the increase of gas velocity. At $M > 2$ the destruction rate increased slowly again. An increase of velocity in the range 0 - 0.8 M at constant temperature increased the corrosive-erosive destruction by 2 - 3 times. The initial stages of scale formation were characterized by a high chemical activity of the gaseous media. The whole process in the investigated velocity and temperature ranges is predominately corrosive. The maximum destructive action was observed under the other equal conditions at angles of 25° - 35° between the specimens and the direction of the gas stream. The second stage of iron destruction-burning begins in a stream at 1100°C and $M \geq 0.8$. There are 17 figures and 29 references: 17 Soviet-bloc and 12 non-Soviet-bloc. The references to the English-language publications read as follows: A.V. Grosse and I.B. Conway, Ind.Eng.Chem. 50, 1958, 4, 663-672; C. Upthegrove and D. Murphy, Trans.Aer.Soc.Steel.

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Corrosive-erosive destruction of ... S/685/61/000/000/003/004
D205/D301

Treat., 21, 73, 1933; D. Murphy, W. Wood and W. Jominy, Trans. Amer. Soc. Steel. Treat., 19, 193, 1931.

Fig. 2. Dimensions and form of specimen.

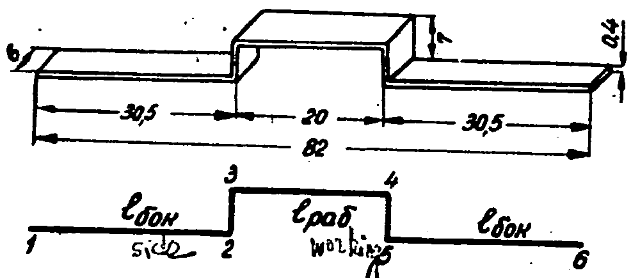

Рис. 2. Размеры и форма образца.

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S/685/61/000/000/004/004
D205/D301

AUTHORS: Prosvirin, V.I. and Yevtikhov, G.V.

TITLE: Influence of high-temperature heating of cold-worked metal on its structure and properties

SOURCE: Akademiya nauk Latviyskoy SSR. Institut avtomatiki i mekhaniki. Prevrashcheniya v splavakh i vzaimodeystviye faz. Riga, 1961, 151 - 161

TEXT: This investigation was sponsored by the Riga Railroad-Car Works. In constructing the electric train-car ЭР-5 (ER-5) the necessity arises for cold plastic deformation of sheet metal (of the 20 КП (20KP) brand) with subsequent welding. Hardened zones may be affected by heat which may in turn lead to substantial changes in structure and properties. The mechanical tests were performed on a 'Шопер' ('Shoper') machine with a deformation velocity of 10 mm/ /min. The specimens were deformed manually on moulds of varying radii (3, 5, 40, 100 mm and ∞). The specimens were then flattened out and tested for tensile strength to establish the properties before heating. Other specimens were heated after deformation to tem-
Card 1/2

Influence of high-temperature ... S/685/61/000/000/004/004 D205/D301

peratures of 600, 700, 800, 900, 1000, 1100, 1200 and 1300°C for times of 2, 5, 10 minutes in a salt bath, cooled in air and tested for tensile strength. The measured tensile strengths and elongation are plotted vs. the normalization temperature for every deformation radius. At all deformations a sharp maximum of the tensile strengths appeared at a normalization temperature of 900°C. Maximum plasticity was observed in specimens which have been normalized at 1000 - 1100°C. Impact tests were performed on specimens of non-standardized dimensions, and a slight decrease of the impact-resistance (of about 11 %) was noted in the heated specimens compared to that of the unheated deformed samples. Comparing the data of the non-deformed samples with the deformed ones, it is seen that cold-working of 20KP steel increased the tensile strength by 10 - 12 % and decreased the plasticity by 15 - 18 %. Heating of the deformed and non-deformed samples did not affect their relative tensile strengths and plasticity. In welded specimens the plasticity decreased in both deformed and non-deformed states by ca. 50 % compared with the elongation of non-welded specimens, while the tensile strength remained unchanged. There are 5 figures, 4 tables and 10 Soviet-bloc references.

Card 2/2

PROSVIRIN, V.I.; VINOGRADSKAYA, Ye.L.; MOLCHANOVA, G.A.

Phase transformations in transition-type steels. Fiz. met. i metalloved. 11 no. 5:775-781 My '61. (MIRA 14:5)

1. Institut avtomatiki i mekhaniki AN Latviyskoy SSR.
(Steel--Metallography) (Phase rule and equilibrium)

235

AUTHOR: Prosvirin, K.S. and Baptizmanskiy, V.I., Dnepropetrovsk Metallurgical Institute, and Kuznetsov, M.P. and Umnov, V.D., Dzerzhinskii Works.

TITLE: Use of magnesium in converter-steel production. (Primenenie magniya pri proizvodstve konverternoy stali.)

PERIODICAL: "Metallurg" (Metallurgist), 1957, No. 1, pp. 16 - 17, (U.S.S.R.)

ABSTRACT: Works trials at the Dzerzhinskii bessemer shop aimed at improving the plastic properties of converter rail steel by treatment with magnesium are described. The magnesium alloy (64% Si, 11.8% Mg) partially or fully replaced the 45% ferro-silicon, used for deoxidation in the ladle, to give the required silicon content. 20 or 60 kg of silicomagnesium were added to various heats, weighing 22.5 tons each. The introduction of magnesium to the liquid steel was found to give a finer grain size, reduce the size and quantity of non-metallic inclusions and the sulphur content, appreciably improve elongation and reduction in area, and give steel with a toughness approximating to that of O.H. steel.
3 tables, 1 graph.

PROSVIRIN, V.I.

129-10-2/12

AUTHOR: Prosvirin, V.I., Professor of Technical Sciences, Doctor, and Chernov, L.F., Engineer.

TITLE: Certain features of changes in the properties of the austenitic steel 10X25H20. (Nekotoryye osobennosti izmeneniya svoystv austenitnoy stali 10X25H20)

PERIODICAL: "Metallovedeniye i Obrabotka Metallov" (Metallurgy and Metal Treatment), 1957, No.10, pp. 5 - 12 (U.S.S.R.)

ABSTRACT: A change in the properties of this austenitic steel is known to be due to secondary-phase transformations. It is also known that this steel can exist in the single phase and in the 2-phase state. During its decomposition, the solid solution evolves a carbide of the type $Me_{23}C_6$ but it was not known that (for this steel) very interesting phenomena can be observed which are associated with changes of certain properties and of the structure. The graph, Fig. 1, gives the dependence of the austenite grain size on the annealing duration for the temperatures 1 200 and 1 300 C; the graph, Fig.2, gives the characteristic of dispersion hardening as a function of the temperature and the duration of the annealing; the graph, Fig. 3, gives the dependence of the dispersion hardening on the duration of the annealing after long duration ageing at

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Certain features of changes in the properties of the austenitic steel 10X25H20. (Cont.)

750 C; the graph, Fig. 4, gives the depedence of the dispersion hardening during stepwise heating; the graph, Fig. 5, shows the changes in the mechanical properties of the steel after various heat treatment regimes; the graph, Fig. 6, gives the influence of the heat treatment on the development of thermal brittleness at 650 C; the graph, Fig. 7, gives the influence of heat treatment on the development of thermal brittleness at 700 C; the graph, Fig. 8, gives the change in the impact strength after heating at 650 C as a function of the tempering regime. On the basis of the results in the here described experiments, it was found that changes in the properties of the steel 10X25H20 during heating were due to secondary phase formation and concentration of these phases along the grain boundaries. The character of the embrittlement is determined by the degree of saturation of the solid solution (austenite). If the saturation of the austenite is considerable, heating to 750 C brings about an appreciable formation of secondary phases and a continuous decrease of the impact strength of the steel. In the case of slight over-saturation of the austenite (by preliminary heat treatment) heating to 650-700 C does not produce appreciable evolution of these phases but the brittle-

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Certain features of changes in the properties of the austenitic steel 10X25H20. (Cont.)

ness of the steel can change within wide limits in accordance with a peculiar relation. The impact strength during isothermal heating at 650 C increases periodically after an initial decrease. Phase and electron-microscopic analysis has shown that maximum ebrittlement of the steel after long duration heating corresponds to the instant of appreciable formation of secondary phases along the grain boundaries. During long duration heating (8 000 hours) σ-phase forms predominantly along the grain boundaries. Secondary phase formation produces interesting changes in the dispersion hardening of the austenite; the characteristic of the dispersion hardening changes in its initial period as a function of the temperature and the duration of the high temperature heating. Thus, for instance, increase in the hardness during the first hours of heating at 650 and 750 C is considerably higher after a very long heating or heating at a very high temperature. Dispersion hardening does not equalise the differences in hardness of the coarse grain and fine grain austenite. Long duration high temperature heating at 1 300 C produces less stable hardening during decomposition, characterised by periodic softening of the austenite in the case of stepwise heating (tempering). Such unstable hardening can

129-10-2/12

Certain features of changes in the properties of the austenitic steel 10X25H20. (Cont.)

be associated with the formation of dimensionally less uniform crystallites of the secondary phase which bring about softening due to coagulation. Embrittlement of the coarse grain austenite takes place more intensively than that of fine grain austenite; this difference is applicable only in the initial period of heating. Formation of secondary phases brings about embrittlement of the steel and leads to interesting relations in the changes of the strength and the ductility characteristics of the steel. Coarser austenitic grain increases the toughness of the steel but reduces its ultimate tensile strength and yield point at any hardness value. The ductility characteristics (δ and ψ) are more sensitive to structural changes than σ_b and σ_s and depend on the dimensions of the austenite grain, the character of the dispersion hardening and the features of the boundary zone. There are 9 figures, 2 tables and 2 Slavic references.

ASSOCIATION: TsNIITMASh

AVAILABLE: Library of Congress

Card 4/4

Prosvirin, V.I.

USSR/Phase Transformation in Solid Bodies. E-6

Abs Jour : Referat Zhur - Fizika, No 5, 1957, 11734

Author : Prosvirin, V.I., Patrina, N.A.
Inst : -
Title : Isothermal Hardening of High-Strength Cast Iron with Spheroidal Graphite.

Orig Pub : Metallovedeniye i obrabotka Metallov, 1955, No 2, 42-50

Abstract : No abstract.

Card 1/1

PROSVIRIN, V. I. AND I. F. ZUDIN

Povyshenie zharoupornosti zhelezougle-rodistykh splavov alitirovaniem.
Moskva, Mashgiz, 1944. 63p. illus.
Bibliography: p. 63-64.

Increase of the resistance to heat of iron carbide alloys by aluminizing.

DLC: TS213. P7

SO: Manufacturing and Mechanical Engineering in the Soviet Union, Library of Congress, 1953.

Mit

Structural nonuniformity of austenite microparticles at high temperatures. V. I. Prosvirin. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk* 1956, No. 6, 117-20.—A study was made to det. if heating a solid soln. of complex compn. to a high temp. can destroy nonuniformity in the microstructure. It was assumed that various closely related elements present in the solid solns. in sufficiently close contact become sufficiently activated at high temps. to oppose the heat-diffusion forces. The methods used were electrolytic etching and detn. of statistical microhardness distribution. Austenitic steel (C 0.1, Cr 23.0, Ni 35.0, Ti 1.2, Nb 1.2, Mo 0.6, and V 1.1%) sections (10 × 10 × 20 mm.) were annealed at 1100° and 1250°. The photomicrographs and the microhardness detns. of the etched samples annealed to above 1250° showed an increased nonuniformity in the single austenite grains. W. M. Sternberg

S/137/62/000/007/041/072
A057/A101

AUTHORS: Vinogradskaya, Ye. L., Molchanova, G. A., Prosvirin, V. I.

TITLE: Peculiarities of phase transitions in steels of the transient class

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 7, 1962, 23 - 24, abstract 7I142 (In collection: "Prevrashcheniya v splavakh i vzaimodeystviye faz". - Riga, AN LatvSSR, 1961, 3 - 49)

TEXT: Kinetics of phase transitions $\gamma \rightarrow \alpha$ and $\alpha \rightarrow \gamma$ in the temperature interval from 700 to -78°C was investigated, as well as processes of separation and dissolving of secondary phases in the interval 350 - 1,050°C with two groups of steels containing the following alloying elements (in %): C 0.07, Cr 15, Ni 5.90 - 7.75, Mo 2.5, Al 0.70 - 1.20 (I) and C 0.07, Cr 12.50, Ni 7.88 - 9.57, Mo 2.5, Al 0.90 - 1.40 (II). The samples were heat-treated under different conditions. The investigation was carried out by microstructure, hardness, and magnetic methods. The obtained hysteresis loops of $\gamma \rightarrow \alpha$ and $\alpha \rightarrow \gamma$ transitions allowed the determination of the critical temperatures of martensitic transitions. It was determined that the austenite of steel I is stable down to -78°C, a stable aus-

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tenitic state of steel II can be obtained only with 9.5% Ni. A rise of the heating temperature from 850 to 1,050°C shows a considerable effect upon the kinetics of subsequent transformations; after a high-temperature heating martensite transformations can be absent due to an increased alloying of austenite. Long holding times at 850 and 950°C effect a separation of the alloying elements from austenite and decomposition of δ-ferrite into a mixture γ'+ carbides, resulting in an impoverishment of the austenite thus promoting a more complete occurrence of martensite transformation at the subsequent cooling. Strengthening is observed in tempering in the interval 300 - 700°C, which is more considerable and occurs at about 500°C in the presence of martensite transformation in the steel; and in the absence of martensite transformation it is less and occurs at higher tempering temperatures (650 - 750°C).

G. Belyayeva

[Abstracter's note: Complete translation]

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S/137/62/000/006/136/163
A057/A101

AUTHORS: Prosvirin, V. I., Nesgovorov, L. Ya.

TITLE: Corrosive-erosive disintegration of iron in a gas stream

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 6, 1962, 89, abstract 6I564 (V sb. "Prevrashcheniya v splavakh i vzaimodeystviye faz", Riga, AN LatvSSR, 1961, 117 - 150)

TEXT: The effect of the velocity of an air stream on the rate of corrosive-erosive disintegration of heated metals was investigated. By means of a specially constructed device (drawing is given) the following effects were studied: 1) the rate of the air stream; 2) temperature of the heated sample; 3) holding time; 4) material and form of the sample; 5) the position of the sample in relation to the inflowing stream; 6) the composition of the oxidizing medium, etc. A regularity was observed for the corrosive-erosive disintegration of Fe in an air stream, which is characterized by a continuous increase of the disintegration rate with increasing velocity of the stream in the subsonic range of frequencies ($0 \leqslant M \leqslant 0.8$), while in the supersonic range ($M \geqslant 1$) until values $M \approx 1.7 - 1.8$

Card 1/2

a decrease of the disintegration rate and at M > 2 a slight increase can be observed. Initial states of scale formation were investigated, which are characterized by the high chemical activity of the gaseous medium. The disintegration process of Fe shows a corrosive character in the temperature range of 800 - 1,000°C and a velocity of $0 \leq M \leq 3$. The effect of the position of the sample in relation to the inflowing stream was studied. The angles of incidence, characterized by the maximum disintegration rate, lie in the range of 25° - 35° for the sub- and supersonic velocity of the stream. Two stages can be observed in disintegration of Fe in the air stream: corrosive-erosive disintegration and combustion. Combustion of Fe starts in the solid phase at a temperature of 1,100°C and a velocity of the air stream of $M \geqslant 0.8$. There are 29 references.

Ye. Layner

[Abstracter's note: Complete translation]

PROSVIRIN, V. I.

E-5

Category : USSR/Solid State Physics - Phase Transformation in Solid Bodies

Abs Jour : Ref Zhur - Fizika, No 5, 1957, No 6655

Author : Prosvirin, V.I., Kvashinina, Ye.I.

Title : Effect of Alloying Elements on the Temper Brittleness of Structural Steels.

Orig Pub : Term. obrabotka i svoystva litoy stali. M., Mashgiz, 1955, 69-87

Abstract : It was established that addition of molybdenum up to 0.5% prevents the development of processes that cause the temper brittleness of structural chrome-nickel-molybdenum and chrome-manganese-molybdenum steels. Greater additions of molybdenum (1% and above) do not affect the temper brittleness. Addition of tungsten up to a definite limit (up to 1.6% for the 35 KhGV steel) retard strongly the development of the temper brittleness of structural steels. X-ray diffraction, carbide, and metallographic investigation methods, as well as measurements of the internal friction and other properties have shown that molybdenum and tungsten, which enter into

Card : 1/2

Category : USSR/Solid State Physics - Phase Transformation in Solid Bodies E-5

Abs Jour : Ref Zhur - Fizika, No 3, 1957, No 6655

the α-solid solution up to a definite concentration, make it stable and prevent the segregation of the carbides on the grain boundaries, a fact that is the fundamental cause of the development of temper brittleness. Additions of titanium, vanadium, and niobium do not prevent the development of temper brittleness in structural steels, i.e., after high-temperature tempering these elements are transformed fully into the carbide phase, owing to their great affinity to carbon.

Card : 2/2

PROSVIRIN, V.I.

Fractional Analysis of Secondary Phases. V. I. Prosvirin, (Zavodskaya Laboratoriya, 1955, 21, (1), 56–60). [In Russian]. The fractional analysis of secondary phases is discussed with special reference to carbides in steel. The analysis consists of two stages: separation of the carbide residue into fractions; the study of these fractions by chemical, X-ray, and other methods. The method proposed enables the composition of secondary phases to be determined with an estimation of the sizes of their crystals.—S. K.

PROSVIRIN, V.I.; MORTIKOV, V.D.

Layer by layer analysis of austenite steel micrograins. Zav. lab. 29 no.9:1059-1060 '63. (MIRA 17:1)

1. Rizhskiy institut inzhenerov Grazhdanskogo vozdushnogo flota.

PROSVIRNIN, A.D.; VAVILOV, Ya.I.

New designs for truck trailers. Avt. i trakt. prom. no.1:8-11 Ja '56. (MIRA 9:6)

1.Gor'kovskiy avtozavod imeni Molotova.
(Automobiles--Trailers)

L 15041-66 EWT(m)/EWP(j)/T/ETC(m)-6 WW/RM

ACC NR: AP6003947 SOURCE CODE: UR/0374/65/000/005/0118/0122

AUTHOR: Prosvirin, V. I. (Riga); Straume, I. Ya. (Riga)

ORG: none

TITLE: Certain properties of the upper layer of the AG-4V fiberglass reinforced plastic

SOURCE: Mekhanika polimerov, no. 5, 1965, 118-122

TOPIC TAGS: fiberglass, thermoplastic material, tensile strength, durability, surface layer, water absorption

ABSTRACT: It was shown that the properties of the upper layer of the AG-4V fiberglass reinforced plastic after compression greatly differ from those of the inner layer. The upper layer is more durable and moisture proof, these properties being determined by the technological parameters of compression. The greatest strength, thickness of the upper layer and the lowest water absorption of the AG-4V fiberglass reinforced plastics were observed at 130C and pressure of 200 kg/cm^2. Under these conditions the microstructure of the layer is characterized by the most even glass fiber distribution without cracking and visible disruptions. Orig. art. has: 7 figures. [Based on author's abstract].

SUB CODE: 11 SUBM DATE: 22Mar65/ ORIG REF: 008/ OTH REF: 001/

Card 1/1 UDC: 678:620.170

ACCESSION NR: AT4049814 S/0000/64/000/000/0068/0072 34 33 B+1

AUTHOR: Prosvirin, V. I.; Yevtikhov, G. V.

TITLE: Rapid carburizing (cyaniding) using pastes with high frequency electric heating

SOURCE: Soveshchaniye po uprochneniyu detaley mashin, 1962. Protsessy uprochneniya detaley mashin (Processes of the hardening of machine parts); doklady soveshchaniya. Moscow, Izd-vo Nauka, 1964, 68-72

TOPIC TAGS: steel carburizing, steel cyaniding, high frequency heating, steel diffusion, iron diffusion

ABSTRACT: Cylindrical samples 16 mm in diameter and 25 mm in length made of iron and various steels were subjected to diffusion saturation in the device shown in Fig. 1 of the Enclosure. A 60-kW unit with a frequency of 350,000 cps was used

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L 40005-65
ACCESSION NR: AT4049814

ing a surface film preventing adsorption. The paste consisted of a filler and binder. The filler was a mixture of yellow potassium ferricyanide, charcoal and barium carbonate. The binder was hydrolized ethyl silicate glue. During hydrolysis of 1 liter of ethyl silicate glue, a solution of 5.4 ml of hydrochloric acid and 0.92 liters of pure acetone in 0.25 liters of distilled water was added. Increasing the carbon powder content makes the paste layer weaker, cracks being formed. The quantity of paste may significantly affect the formation of the diffusion layer. Tests were performed as follows: maximum heating was up to 1150C, duration for reaching this temperature- 20 sec, heating at maximum temperature - 30 sec. Hardness tests showed that a paste layer of 1.5 mm was sufficient. Rapid heating ensured maximum surface hardness. Lowering of the heating rate resulted in maximum hardness at some depth

1100 kg/mm² depending on the ...

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L 40005-65
ACCESSION NR: AT4049814

and corrosion resistant. Brief high-temperature heating does not lead to noticeable growth of micrograins. Orig. art. has: 6 figures.

ASSOCIATION: None

SUBMITTED: 21May64 ENCL: 01 SUB CODE: MM

NO REF SOV: 000 OTHER: 000

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Card 3/4

L 39998-65 EWT(m)/EWP(w)/EWA(d)/T/EWP(t)/EWP(z)/EWP(b) MJW/JD/GS

ACCESSION NR: AT4049811 S/0000/64/000/000/0039/0046

24
21
B+1

AUTHOR: Prosvirin, V. I.; Tarasov, B. Ya.

TITLE: Rapid nitriding by heating with high frequency currents 18

SOURCE: Soveshchaniye po uprochneniyu detaley mashin, 1962. Protsessy uprochneniya detaley mashin (Processes of the hardening of machine parts); doklady soveshchaniya. Moscow, Izd-vo Nauka, 1964, 39-46

TOPIC TAGS: steel nitriding, cast iron nitriding, rapid nitriding, high frequency nitriding, surface hardness, fatigue strength 18

ABSTRACT: The main disadvantage of nitriding as a method of hardening by thermal diffusion is the duration of the process, which requires scores of hours. Inves- ... nitriding with high-frequency currents

For both methods, the sample was

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L 39998-65

ACCESSION NR: AT4049811

temperature was measured by a thermocouple, the duration was taken from the time the unit was switched on, and the microhardness was measured by the PMT-3 device ... load of 3 grams. One of the main factors determining the results of ni- ... which depends on its tem-

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L 39998-65

ACCESSION NR: AT4049811

3

surface hardness could also be obtained by short-term nitriding of common perlitic
and high-strength magnesium cast iron. The best results in nitriding of cast iron
are obtained at 850C when a surface hardness of 900kg/mm^2 is obtained, while ni-
triding of high-strength cast iron at 900C results in a hardness of 600 kg/mm^2.
During nitriding, different layer thicknesses are obtained; for two minutes;
with iron - 0.04-0.09 mm, 45Kh steel - 0.03-0.05 mm, cast iron - up to 0.10 mm;
for ten minutes: with 38KhMYuA steel - up to 0.08-0.10 mm. This was verified by
The total diffusion depth, however, exceeds these values.

in ferrite, the fatigue strength is increased more than ...
7 figures.

ASSOCIATION: None

SUBMITTED: 21May64 ENCL: 00 SUB CODE: MM

NO REF SOV: 001 OTHER: 001

Card 3/3

ACCESSION NR: AT4040795

5 x 20 mm specimen after deformation. The results of phase transformation and microhardness tests are graphed. It is concluded that two basic phases are preserved in the structure of austenitic-ferritic steel after all possible variations in treatment - austenite and delta-ferrite as separate grains of various sizes and form. In the process of high-temperature annealing, diffusional interchange may occur between the grains of austenite and delta-ferrite, producing variations in the concentration of alloying elements in these phases. As the result of such an exchange, the properties and structure of the grains are changed, and correspondingly also the final properties of the alloy. As shown by microhardness distribution, grains of austenite and delta-ferrite are heterogeneous with regard to their composition, even within the limits of a micrograin. Cold plastic deformation strengthens austenite grains to a higher degree than delta-ferrite grains. Because of the considerable heterogeneity in composition of the grains, their strengthening due to phase transformation, precipitation, or plastic deformation is non-uniform. Drawing of an alloy at 600 C reduces the strength of the grains in phases obtained by quenching from high temperatures (1050; 1200 C) and strengthens the grains in phases obtained by quenching from low temperatures (850 C). Orig. art. has: 5 graphs and 25 photomicrographs.

Card 2/3

ACCESSION NR: AT4040795

ASSOCIATION: Institut avtomatiki i mekhaniki AN LatSSR (Institute of Automation and Mechanics, AN Lat SSR)

SUBMITTED: 00 ENCL: 00

SUB CODE: MM NO REF SOV: 011 OTHER: 005

Card 3/3

L 13049-65 EWT(m)/EWP(w)/EWA(d)/EWP(t)/EWP(b) ASD(d)/ASD(p)-3/ASD(m)-3/ AFTC(a)/AEDC(b) MJW/JD/JT/MLK

ACCESSION NR: AT4046837 S/0000/64/000/000/0166/0171

AUTHOR: Prosvirin, V. I.; Zaytsev, A. I.; Mortikov, V. D. B

TITLE: Effect of operating temperature on the properties of alloy EI-437 19

SOURCE: AN SSSR. Nauchnyky sovet po probleme zharoprochnykh splavov. Issledovaniya staley i splavov (Studies on steels and alloys). Moscow, Izd-vo Nauka, 1964, 166-171

TOPIC TAGS: gas turbine, high temperature alloy, heat resistant alloy, alloy mechanical property, alloy hardness, alloy strength, alloy aging / EI-437 alloy

ABSTRACT: The gas turbines used up to the present time do no produce any signifi-

L 13049-65
ACCESSION NR: AT4046837

of 12 mm were heated at 550, 600, 650 and 700C for 3, 6, 12, 36, 72, 144, 300, 600 and 800 hours, after which the mechanical properties were determined at 20, 550, 600, 650 and 700C. Stress-rupture strength was determined at 600C (68 kg/mm^2) and 700C (42 kg/mm^2). The impact toughness was determined on standard notched samples (10x10x55 mm) and rupture samples (6x70 mm) during 2-4 parallel tests. The results showed a significant drop in hardness at 550C after 300 hours, while at 600C the drop was less, and at 650 and 700C there was no decrease in hardness. The impact toughness decreased with time at all aging temperatures, especially at 600C; an increase in impact toughness was only observed after a relatively short time at 700C. Under short-term tensile stress, the ultimate strength and yield point changed only slightly up to 300 hours of aging. After 600 hours, the nature of the variations changed, and the minimum ultimate strength was observed at the maximum yield point. The stress-rupture strength also decreased after 300

ASSOCIATION: none 18

SUBMITTED: 16Jun64 ENCL: 00 SUB CODE: MM

Card 2/2 NO REF SOV: 010 OTHER: 000

L 13048-65 EWT(m)/EWA(d)/EWP(t)/EWP(b) Pad ASD(m)-3 MJW/JD/HW/MLK

ACCESSION NR: AT4046836 S/0000/64/000/000/0159/0165

AUTHOR: Prosvirin, V. I.; Mortikov, V. D. B

TITLE: Variation in properties of alloy EI-617 during prolonged high temperature heating 18 18

SOURCE: AN SSSR. Nauchny*y sovet po probleme zharoprochny*kh splavov. Issledovaniya staley i splavov (Studies on steels and alloys). Moscow, Izd-vo Nauka, 1964, 159-165

TOPIC TAGS: heat resistant alloy, alloy hardness, nickel alloy, alloy plasticity, alloy strength / alloy EI-617 27

ABSTRACT: Most alloys consist of many components, one or more of which may have limited solubility. During high-temperature annealing, however, the excess phases dissolve and unsaturated solid solutions are formed with a uniform chemical com-

L 13048-65
ACCESSION NR: AT4046836

properties of alloy EI-617 which contains, besides Ni: 0.08% C, 14.87% Cr, 1.85% Al, 1.93% Ti, 5.71% W, 3.65% Mo, 0.6% Si and 0.14% V. The initial state of the alloy was produced by double annealing: at 950C for 7 hours and at 850C for 10 hours. The high-temperature instability of the alloy was determined by heating at 1200C for 1, 3, 6, 12, 24, 36, 48 and 96 hours, and at 1300C for 1, 3, 6 and 12 hours, after which the samples were tested for heterogeneity of the solid

L 13048-65
ACCESSION NR: AT4046836

to a maximum at about 20 hours. The results of mechanical tests show that when the duration of primary hardening is increased from 2 to 12 hours at 1190C, or up to 5 hours during the second stage of hardening, the ultimate strength is decreased from 115 to 75 kg/mm^2, the relative elongation drops from 25 to 2%, and the contraction at break changes from 25 to 3-5%. Further prolongation of high-temperature treatment leads to restoration of the mechanical properties of the alloy. A slight increase in impact toughness (0.5 kg-m/cm^2) is observed when the duration of heat treatment at 1190C is increased from 2 to 5 hours. The stress-rupture strength drops only 13% when the duration of heat treatment is 96 hours. The relative elongation and contraction decrease continuously as the duration of alloy heating increases. Repeated hardening at 1050C does not restore the properties of the alloy, leading, on the contrary, to further deterioration. Orig. art. has: 8

PROSVIRIN, V.I.; YEVTIKHOV, G.V.

Rapid, high-temperature cyaniding by paste and high-frequency current heating. Metalloved. i term. obr. met. no.3:29-33 Mr '64. (MIRA 17:4)

PROSVIRIN, V.I., doktor tekhn.nauk, red.; VINOGRADSKAYA, Ye.L., kand. tekhn. nauk, red.; TARASOV, B.Ya., red.; TEYTEL'BAUM, A., red.

[Transformations in alloys and the interaction of phases] Prevrashchenia v splavakh i vzaimodeistvie faz. Riga, Izd-vo AN Latv.SSR. Vol.2. 1963. 94 p. (MIRA 17:4)

1. Latvijas Padomju Socialistiskas Republikas Zinatnu Akademija. Automatikas un mekhanikas instituts.

NESGOVOROV, L.Ya.; PROSVIRIN, V.I.

Disintegration of heated metals and alloys in a supersonic air flow. Inzh.-fiz.zhur. 6 no.2:44-51 F '63. (MIRA 16:1)

1. Institut inzhenerov grazhdanskogo vozdushnogo flota SSSR, Riga.
(Aerodynamics, Supersonic) (Alloys--Testing)

PROSVIRIN, V.; MORTIKOV, V.

Structure of a composite solid solution after high temperature heating. Vestis Latv ak no.2:65-70 '61.

1. Institut avtomatiki i mekhaniki AN Latviyskoy SSR.

S/123/62/000/011/001/011
A052/A101

AUTHORS: Prosvirin, V. I., Yevtikhov, G. V.

TITLE: The effect of high-temperature heating of cold-hardened metal on its structure and properties

PERIODICAL: Referativnyy zhurnal, Mashinostroyeniye, no. 11, 1962, 20, abstract 11A120 (V sb. "Prevrashcheniya v splavakh i vzaimodeystviye faz". Riga, AN LatvSSR, 1961, 151 - 161)

TEXT: The effect of heating of cold-hardened 20 КП (20KP) steel on its structure and properties was studied. The cold hardening was produced by bending the samples in transverse direction on guides of 3, 5, 40 and 100 mm radius and by subsequent straightening between steel plates. To determine the effect of high-temperature heating, the samples were exposed to 600 - 1,300°C during 2 - 10 min with air cooling. The subsequent tensile and notch toughness test has shown that the bending deformation increases the strength by 10 - 12% and decreases the ductility by 15 - 18% compared with the initial state. The normalizing of cold-hardened steel increases σ_b and decreases the ductility. After cold-

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hardening and normalizing A_k decreases by 10 - 12%. The welding decreases the ductility both of deformed and undeformed samples by 50%, σ_b remaining unchanged.

[Abstracter's note: Complete translation]

S/137/62/000/005/125/150
A160/A101

AUTHORS: Prosvirin, V. I., Tarasov, B. Ya.

TITLE: Nitriding with the use of high-frequency current heating

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 5, 1962, 132, abstract 5I799 (V sb. "Prevrashcheniya v splavakh i vzaimodeystviye faz." Riga, AN LatvSSR, 1961, 51 - 87)

TEXT: The nitriding with the use of high-frequency current heating was carried out with test pieces from Armco-Fe (0.04% C), 45 X (45Kh) steel, 38XMЮA (38KhMYuA) steel (0.35% C, 1.54% Cr, 0.63% Al, 0.16% Mo) and perlite iron in a special installation. The nitriding was conducted in the flow of NH_3 in two variants. 1) At a constant temperature, or more precisely - under slowly-increasing temperature conditions. The maximum heating temperature was considered to be the nitriding temperature (for Armco-Fe - 775, 790, 815, 910, 1,020°C, for the 38KhMYuA steel - 950-750°C, and for the iron - 850°C). The nitriding time was the period from switching on the installation and the beginning of the heating of the pieces. 2) Within a fixed temperature range (mainly at temperatures of <750°C). After the nitriding, the pieces were cooled in water. Subsequently,

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S/137/62/000/005/125/150
A160/A101

Nitriding with the use of...

one part of them was subjected to tempering. A description is given of the experimental method. The nitriding lasted 2 - 30 minutes. There is an optimum consumption of NH_3 at each temperature of nitriding. A change of the nitriding temperature within 775 - 1,020°C has its strongest effect on the absorption of N by iron at a consumption of 1.6 - 3.2 l of NH_3 per minute. The investigations revealed that it is possible to nitride Fe and steels when heating with high-frequency currents (2 - 10 minutes), whereby sharply-defined nitrous phases are obtained in the diffusion layer. The maximum absorption of N by iron is noted when nitriding at 815 - 910°C, and by the 45Kh steel - at 860°C. When nitriding for a short time, a visible diffusion layer is obtained for Fe at temperatures of up to 910°C, and for the 45Kh steel - at temperatures of up to 860°C. The layer consists of an exterior zone of acicular crystals (phase ε), and of an interior zone from nitrous austenite and nitrous martensite. When nitriding Fe at 1,020°C and the 45Kh steel at $>$ 900°C, a homogenous diffusion layer was obtained from nitrous martensite and troostite martensite. When nitriding the 38KhMYuA steel for 10 minutes and 45Kh steel for 2 minutes, diffusion layers with a surface Hv 1,100 - 1,200 kg/mm^2 are obtained. The highest surface-hardness values are obtained for 38KhMYuA steel and 1,500 kg/mm^2 for the 45Kh steel.

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Nitriding with the use of...

S/137/62/000/005/125/150
A160/A101

after the pieces were tempered (nitrided at 600 - 650°C). A short nitriding with quenching secures a high Hv in perlite cast iron. There are 22 references.

A. Babayeva

[Abstracter's note: Complete translation]

Card 3/3

37840

S/123/62/000/008/016/016
A004/A101

18.7500

AUTHORS: Vinogradskaya, Ye. A., Molchanova, G. A., Prosvirin, V. I.

TITLE: The specific features of phase transformations in transition type steels

PERIODICAL: Referativnyy zhurnal, Mashinostroyeniye, no. 8, 1962, 2, abstract 8G12 (V sb. "Prevrashcheniya v splavakh i vzaimodeystviye faz". Riga, AN LatvSSR, 1961, 3-19)

TEXT: The authors have plotted hysteresis loops of $\gamma \to \alpha$ and $\alpha \to \gamma$ transformations for a group of steels of the transition class, which are characterized by a variable nickel and aluminum content. These loops, showing the nature and kinetics of transformations, made it possible to establish the "critical" temperatures of martensite transitions. It was found that alloys of this category containing 7.75% nickel at a Cr-content of 15% pertain to the group of steels whose austenite is stable down to -78°C. If the Cr-content is reduced to 12.5%, the nickel content of the alloy should be increased to 9.5% to obtain a stable austenitic state. Increasing the heating temperature from 850 to 1,050°C considerably affects the kinetics of all subsequent transformations.

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S/123/62/000/008/016/016
A004/A101

The specific features of phase ...

If the temperature is increased, a diffusion of the secondary phases is taking place, which results in the solid solution being enriched with alloying elements, increasing its stability. Therefore, steels of this category may not have a martensite transformation after high-temperature heating. A protracted holding of the steels at such high temperatures as 850 - 950°C leads to precipitation processes of excess alloying elements and compounds from austenite and to a decomposition of δ-ferrite into a mixture consisting of γ' and carbides. In both cases, the formation of less alloyed austenite promotes a more complete martensite transformation during the subsequent cooling. The preceding heat treatment, during which $\gamma \rightarrow \alpha$ and $\alpha \rightarrow \gamma$ transformations were taking place, lowers the stability of austenite formed at high-temperature heating and contributes to its more complete transformation during the subsequent cooling. Hardening is effected up to 500°C in the case of a partial or full martensite transformation preliminarily taking place in the steel. The more complete the martensite transformation, the more considerable is the effect of precipitation hardening. A hardening of the steels may take place as a result of the secondary phase precipitating from the austenite subjected to phase workhardening in the process of martensite transformation. The energy additionally imparted to the steel on account of deformation during phase workhardening lowered the stability X

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of austenite during heating and moreover, caused a precipitation of the secondary phases at a lower temperature. High-temperature hardening (700 - 750°C) is accompanied by diffusion processes of precipitation in the solid solution and can be observed in those cases in which the steel is not undergoing a preliminary martensite transformation during the heat treatment. Hardening is taking place during the precipitation of secondary phases from the solid γ-solution which is analogous to the hardening of austenitic and heat-resistant steels.

[Abstracter's note: Complete translation]

X

PROSVIRIN, V.I.

Changes in the state of a nickel-base solid solution at high temperatures. Issl. po zharopr. splav. 7:142-150 '61. (MIRA 14:11)

(Nickel alloys--Metallography) (Metals at high temperature)

PROSVIRIN, V.I.

Directional deformations during cyclic heating. Issl. po zharopr. splav. 7:349-362 '61. (MIRA 14:11)
(Metallography) (Metals--Heat treatment)

34527
S/659/61/007/000/014/044
D217/D303

18.1150

AUTHOR: Prosvirin, V.I.

TITLE: Change in state of nickel-base solid solutions

SOURCE: Akademiya nauk SSSR. Institut metallurgii. Issledovaniya po zharoprochnym splavam, v. 7, 1961, 142 - 150

TEXT: The influence of long-term heating on the state of a solid solution of the following composition was investigated: 0.08 % C, 14.5 % Cr, 1.93 % Ti, 1.85 % Al, 5.7 % W, 6 % Mo, 1.6 % Fe. Forged specimens were at first annealed at 950°C for 7 hours, followed by a second anneal at 850°C for 10 hours. A study of the effect of heating periods of between 9 and 96 hours was carried out at 1200°C and the influence of periods of between 1 and 12 hours at 1300°C was also examined. All specimens (10 mm thick) were quenched in cold water after heating, in order to retain the structure of the high-temperature state. The micro-hardness was measured at a load of 50 g. Curves for the distribution frequency of microhardness levels were plotted from 200 repeated measurements and the resistance X

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to plastic deformation was determined. It was found that during long-term soaking at high temperatures, a number of alloying elements pass from solid solution to zones of concentration where compounds are formed. The diffusion mobility of these atoms is strictly limited, and their concentration in definite regions must show up in the change of crystal lattice parameter of the basic solid solution. Measurements of the lattice parameter of the solid solution in question at 20°C have shown that the maximum value of the parameter (4.6063 KX) corresponds to one hour's heating at 1200°C, when the main bulk of secondary phases has dissolved in the solid solution. Longer heating periods lead to a constant decrease of this parameter, which after 96 hours' heating becomes 4.6042 KX. This may indicate that a certain proportion of alloying elements which expand the crystal lattice of the solid solution, leave the latter and concentrate in certain zones, eventually losing coherence with the mother solution at some point. The 'collective' diffusion in unsaturated solid solutions, caused by the interaction of different atoms, leads to local hardening of some regions and to softening of others. At definite stages of development of these diffusion pro-

X

cesses, the strength properties of the solid solution pass through minimum and maximum values. The change of the latter with time of heating can be estimated by the force characterizing resistance to plastic deformation. The conditions of the solid solution corresponding to the minimum strength values tends to more intense dispersion hardening than that corresponding to the maximum. Heating complex, heat-resistant alloys to excessively high temperatures can lead to an even more rapid formation of concentration complexes and possibly to melting. There are 6 figures, 1 table and 22 references: 18 Soviet-bloc and 4 non-Soviet-bloc. The references to the English-language publications read as follows: R. Smoluchowski, Phys. Rev. 84, no. 3, 1951; P.S. Rudman and B. Averbach, Acta Met., 2, 1954; P.S. Rudman, P.A. Flinn, and B. Averbach, J. Appl. Phys., 24, 265, 1953.

34553
S/659/61/007/000/042/044
D205/D303

18.6700

AUTHOR: Prosvirin, V.I.

TITLE: On directed deformation at cyclic heatings

SOURCE: Akademiya nauk SSSR. Institut metallurgii. Issledovaniya po zharoprochnym splavam, v. 7, 1961, 349 - 362

TEXT: This work was undertaken to supplement the existing theories which do not give a satisfactory explanation of the mechanism of deformation during a repetitive thermal cycle. The results are given of an investigation of deformation kinetics of Fe and Ni and the factors of the fading character of the irreversible deformations induced by the thermal cycle are described. Technical nickel strip, Armco iron (0.02 % C, 0.1 % Si) and cast Al were investigated. Size of the Fe and Ni specimens was 50 x 20 x 5 mm. The Ni and Fe specimens were heated in molten salts, the Al in air and in steam. Quenching was by water, (20°C) and the upper temperature limit of each cycle was changed from 500° to 800°C. The heating time was 3 minutes. The specimen dimensions were measured after every 10 - 20

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cycles. It was found that the cyclic thermal treatment Ni always increased in length and width and decreased in thickness, while iron behaved in an opposite manner. These changes depended upon the higher temperature limit of the cycle. The change in dimensions for Ni increases relatively steeply with the upper cycle temperature limit, while for Fe the change after 700°C is negligible. The change in dimensions versus the number of cycles shows that initially the change is largest and is described by periods of constant rate, each consecutive period being slower than the preceding one. The theory of the deformation is discussed in detail. Anisotropy of the plastic and rigid properties of the crystals is thought to be one of the reasons for the non-coincidence of the relative shifting of conjugated elements with the direction of the temperature gradient. At the constant sign changing of the direction the material develops fatigue through the formation of intercrystalline microfractures. The process of deformation is discussed and illustrated stage by stage. Additional evidence on the influence of the microcracks on the kinetics of the deformation was gained by an experiment with Al, using in one series of runs air and in the second H_2O X

APPROVED FOR RELEASE: 09/19/2001 CIA-RDP86-00513R001343320001-4"

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On directed deformation at cyclic... D205/D303

vapor as the heating medium. It is argued that if at an early stage in the process microcracks are formed, their filling by foreign atoms would be reflected on the kinetics of the process. In the case of filling, the transfer of the deformation will be easily effected from volume to volume, increasing the probability of local plastic deformations. Thus air with predominantly molecular oxygen can fill only large cracks by oxidation, while H_2O vapor containing primarily atomic oxygen is capable of filling the microcracks. In fact, the deformation in the experiments using H_2O vapor as the heating medium was almost twice as high as in the case of heating in air. The special contribution of A.A. Bochvar to the field is mentioned. There are 10 figures and 33 references: 21 Soviet-bloc and 12 non-Soviet-bloc. The 4 most recent references to the English-language publications read as follows: D.S. Wood and D.S. Clark, Trans.Amer.Soc.Metals, 43, 1951; T. Karman and P. Duwes, J. appl. phys., 21, 1950; F.P. Bowden, Symposium on Internal Stresses in Metals and Alloys, London, 1948; P. Haythorn, Iron Age, 162, no. 13, 1948.

Card 3/3

X

~~PROSVIRIN, V.I.~~

Mechanism of directional metal deformation under the effect of cyclic heat treatment. Fiz. met. i metalloved. 11 no. 5:782-793 My '61. (MIRA 14:5)

1. Institut avtomatiki i mekhaniki AN Latviyskoy SSR.
(Metals, Effect of temperature on)
(Metallography)

PROSVIRIN, V.I., prof., doktor tekhn. nauk, red.; BAZHANOVA, S., red.; KREMER, L., tekhn. red.

[Transformations in alloys and the interaction of phases] Prevrashcheniia v splavakh i vzaimodeistvie faz. Pod red. V.I.Prosvirina. Riga, Izd-vo Akad.nauk Latviiskoi SSR, 1961. p. (MIRA 14:12)

1. Latvijas Padomju Sotsialistiskas Republikas Zinatnu akademija. Automatikas un mehanikas instituts.
(Alloys--Metallography) (Phase rule and equilibrium)

PROSVIRIN, V.I.; NESCOVOROV, L.Ya.

Corrosive disintegration of heated iron in a high-speed flow of cold air. Dokl.AN SSSR 138 no.3:628-630 My '61. (MIRA 14:5)

1. Predstavleno akademikom A.A.Bochvarom.
(Iron--Corrosion)

PROSVIRIN, V.I.(Riga); VINOGRADSKAYA, Ye.(Riga); MOLCHANOVA, G.(Riga)

Phase changes of transient class steels by deep cooling. Vestis Latv ak no.10:65-70 '60. (EEAI 10:9:10)

1. Akademiya nauk Latviyskoy SSR, Institut mashinovedeniya.

(Steel)

PROSVIRIN, V.(Riga); TARASOV, B. (Riga)

Nitration of steel by using high-frequency current for heating. Vestis Latv ak no.11:43-48 '60. (EEAI 10:9)

1. Akademiya nauk Latviyskoy SSR, Institut avtomatiki i mekhaniki.

(Nitration) (Steel) (Electric currents)

PROSVIRIN, V. (Riga); VINOGRADSKAYA, Ye. (Riga); MOLCHANOVA, G. (Riga)

Dispersion hardening of some high alloy steels. Vestis Latv ak no.12:
39-42 '60. (EEAI 10:9)

1. Akademiya nauk Latviskoy SSR, Institut energetiki i elektrotekhniki.

(Steel)

PROSVIRIN, V. (Riga); MORTIKOV, V. (Riga)

Structure of composite solid solution after heating to high temperature. Vestis Latv ak no.2:65-70 '61. (EEAI 10:9)

1. Akademiya nauk Latviyskoy SSR, Institut avtomatiki i mekhaniki.

(Solutions)

PROSVIRIN, V.I. (Riga); NESGOVOROV, L. Ya. (Riga)

Effect of high velocity air flow on the distruction of heated iron. Izv. AN. SSSR. Otd. tekh. nauk. Met. i topl. no.2:124-131 Mr-Ap '61. (MIRA 14:4)

(Iron—Corrosion)

APPROVED FOR RELEASE: 09/19/2001 CIA-RDP86-00513R001343320001-4"

PROSVIRIN, V.I. (Riga); TARASOV, (Riga)

Rapid nitriding of steels by heating with high frequency currents.
Izv. AN. SSSR. Otd. tekh. nauk. Met. i topl. no.2:132-140 Mr-Ap '61.
(MIRA 14:4)

(Induction hardening)
(Case hardening)

26

Distr: 4E2c

Kinetics of thermal embrittlement of certain austenitic steels. V. I. Presylin and L. F. Chernov. *Issledovan. po Zharoprochn. Splavam, Akad. Nauk S.S.S.R., Inst. Met. im. A. A. Baikova* 1956, 70–83.—A steel with C 0.13, Cr 24.6, Ni 40.4, W 3.25, Mo 0.57, Ti 0.97, and V 1.1% was annealed at 920°, quenched at 1150 and 1250° after heating at this temp. for 1 and 24 hrs., and tempered at 700° for up to 1000 hrs. Curves of impact strength, tensile strength, and yield point show that both the time at the quenching temp. and its magnitude have a pronounced effect. The impact strength of a specimen quenched from 1250° dropped to 1 kg./sq. cm. in 10 hrs. after soaking for 6 hrs., and in 200 hrs. after the time at the quenching temp. was 1 hr. Pptd. 2nd phases were sepd. electrolytically in a soln. of KCl 300, Na citrate 30, and HCl 50 g./l. by using 1 amp./sq. cm.; they were then analyzed. There is a greater pptn. of elements with a longer quenching time, but the rate differs; Cr, Ni, and Fe lead, while Nb can be completely sepd. from the solid soln. A lower temp. reduces both the total amt. and the rate of pptn. Tempering at 650° following tempering at a higher temp. causes a change in hardness and impact strength which depends on the original treatment and the time of 2nd tempering.

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MIKHAYLOV-MIKHEYEV, Prokopiy Borisovich, doktor tekhn. nauk; PROSVIRIN, V.I., doktor tekhn. nauk, prof., retsenzent; LEVIN, Ye.Ye., kand. tekhn. nauk, red.; VASIL'YEVA, V.P., red. izd-va; MITARCHUK, G.A., red. izd-va; PETERSON, M.M., tekhn. red.

[Handbook of metal materials used in the manufacture of turbines and engines] Spravochnik po metallicheskim materialam turbino- i motorostroeniia. Moskva, Gos. nauchno-tekhn. izd-vo mashino-stroit. lit-ry, 1961. 838 p. (MIRA 14:9)

(Metals) (Turbines) (Engines)

S/126/61/011/005/012/015
E073/E335

AUTHORS: Prosvirin, V.I., Vinogradskaya, Ye.L. and Molchanova, G.A.

TITLE: On Phase Transformations in Steels of the Intermediate Class

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol. 11, No. 5, pp. 775 - 781

TEXT: Steels of the intermediate class, i.e. intermediate from martensitic to austenitic, are characterised by a combination of properties and phase-transformations which are characteristics for both martensitic and austenitic steels. The results are described of investigations of phase-transformations in three steels of this class. Of these, Steel 1 is nearer to the martensitic class, Steel 3 is nearer to the austenitic and Steel 2 occupies an intermediate position between the two. The contents of C, Cr and Mo were maintained constant and the quantities of Ni and Al were slightly varied (C 0.07%, Mn 0.07%, Si 0.4%, Cr 12.5%,

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Ni 7.8-8.8%, Al 1.4-1.1%). The ratios of the yield point to the UTS for the Steels 1, 2 and 3 after normalisation treatment at 1 050 °C are, respectively, 0.76, 0.23, 0.21. After a second normalisation treatment at 950 °C and additional cooling to -70 °C, followed by subsequent ageing at 500 °C for one hour, these ratios reached values of 0.9. For a maximum value of $\sigma_{0.2T}$ = 150 kg/mm² for Steel 1, δ = 14% and ψ = 54% were achieved. A feature of these steels is that they occupy a very narrow range as regards composition, which involves practical difficulties during manufacture. An increase in the hardening temperature from 850 - 1 050 °C (air quenching) brings about a large increase in the quantity of the residual austenite, particularly in Steel 3 which is nearer to the austenitic-class steel. Fig. 1a shows the influence of the hardening temperature, °C, on the quantity of the residual austenite, A, %, and on the hardness HV. Fig. 1б shows the decrease in the quantity of the austenite (Δ A, %) and the increase in the hardness ΔHV as functions

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of the hardening temperature, °C, after cooling the specimens to -194 °C. The influence of stepwise heat was also investigated. All the steels were subjected to stepwise heating for one hour at 350, 500, 650 and 800 °C for one hour, with intermediate cooling at room temperature, after initial cooling to 15 °C and after cooling to -194 °C. Regardless of the original hardening temperature the steels hardened considerably (by 40-50%) as a result of subsequent heating to 500 °C. However, the quantity of austenite remained practically unchanged and this indicated that precipitation-hardening occurred; reheating even to 650 °C resulted in a decrease in hardness which was still higher than the original value; the austenite quantity increased by about 12% for all the tested original hardening temperatures. A further heating of the specimens to 800 °C brought about a further decrease in hardness and a decrease in the quantity of austenite. The increase in the quantity of austenite on heating to 650 °C is due to reversible martensitic transformations during heating. To reveal more clearly the nature of the hardening

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of the hardened steels during stepwise heating, the temperature steps were made more close. Each specimen was first heated to 350 °C for one hour, cooled to 20 °C, again heated to 400 °C, cooled to 20 °C, reheated to 450 °C, etc., the maximum temperature being 1 050 °C. The preliminary heat-treatment was hardening from 950 and 1 050 °C and part of the specimens were first subjected to cooling to -78 °C. The obtained results show that the increase in hardness of the alloy on heating it to 500-550 °C will be the more intensive the more complete the martensitic transformation. The close temperature steps used in experiments have revealed a very interesting feature, namely, that regardless of the original heat-treatment the steel tends to reach a certain limit hardness of about 300 Vickers units, which is conserved up to temperatures of 900-950 °C. The nature of precipitation-hardening during ageing was investigated for hardened steel, heated to 400, 450, 500, 700 and 800 °C for durations of 1 to 36 hours; part of the specimens were deep-cooled to

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-194 °C for 20 min prior to heating. The results confirmed that precipitation-hardening in the temperature range 400 - 500 °C was associated with rejections from phase-hardened austenite. If the martensite point was not reached during hardening but the final cooling temperature was near to the martensite point, a slow precipitation-hardening was also observed. This may be due to diffusional development of martensitic nuclei which do not develop into martensitic transformation. Phase-hardening by precipitation-hardening produces hardening of the austenite which is unstable and decreases on prolonged heating to 500 °C. Higher heating temperatures produced active processes of rejection, dissolution and coagulation. Results obtained for steels aged at 700 and 800 °C indicated that regardless of the original state, steel heated to temperatures up to 700 °C tended to reach a hardness of 300 kg/mm^2 after 36-40 hours. At 800 °C the process of coagulation of secondary phases was more intensive and had a considerable influence on the process of softening; at 800 °C both hardening and softening proceed simultaneously. There are 7 figures, 1 table and 10 references: 6 Soviet and 4 non-Soviet. The four English-language references quoted are: Ref. 3 - A. Gibraith, Austral Machinery, 1958, 11, No. 117, 23; Ref. 4 - (Review) Iron Age, 1958, 181, No. 22, 88; Ref. 5 - (Review) West Metals, 1957, 15, No. 10, 62; Ref. 6 - R. White, Metal Progress, 1958, 112, 51.

ASSOCIATION: Institut avtomatiki i mekhaniki AN Latviyskoy SSR (Institute of Automation and Mechanics of the AS Latvian SSR)

SUBMITTED: August 29, 1960

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E193/E183

AUTHOR: Prosvirin, V.I.

TITLE: On the mechanism of oriented deformation of metals due to thermal cycling

PERIODICAL: Fizika metallov i metallovedeniye, Vol.11, No.5, 1961, pp. 782-793

TEXT: The object of the present investigation was to study the kinetics of the irreversible changes of shape which take place in Fe, Ni and Al, as a result of thermal cycling, and to find an explanation for the decaying character of the irreversible deformation/number of thermal cycles relationship. The experiments were conducted on commercial grade, anode nickel, armco iron (0.02% C, 0.01% Si), and cast Al grade A00 (A00). The nickel and iron test pieces (measuring 50 x 20 x 5 mm) were heated by immersion in a salt bath. The aluminium specimens (30 x 10 x 2 mm) were heated in a stream of air or water vapour. The upper limit of the thermal cycling varied between 500 and 800 °C, the time at the temperature being 3 min. The test pieces were cooled by quenching in water at 20 °C. The dimensions of the specimens were measured
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after each 10-20 cycles. The length and width of the nickel specimens increased and their thickness decreased as the result of this treatment. In the case of the iron specimens, the length and width decreased and the thickness increased. Some of the results are reproduced in Fig.1, where the increase in length (%) of nickel (lower curves, left-hand scale), and the decrease (%) in length of iron (upper curves, right-hand scale) specimens are plotted against the upper temperature (°C) of the cycle, curves 1, 2 and 3 relating to the dimensional changes after 100, 200 and 300 cycles respectively. These results confirmed the previously established fact that the magnitude of the dimensional changes due to thermal cycling increases with the increasing amplitude of the temperature variation, and that after a certain number of cycles the rate at which the dimensions of the test piece change, decreases. The latter effect is also illustrated in Fig.2, where the increase (%) in length (dots) and width (crosses) of nickel specimens (upper curves, left-hand scale), and the increase in length of iron specimens (lower curve, right-hand scale) are plotted against the number of thermal cycles (20 - 700 - 20 °C). It will be seen that each curve can be divided into three linear
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portions representing three stages of the oriented, irreversible deformation taking place at progressively slower rates. The following explanation of this effect is proposed. Under the conditions of thermal cycling with fast heating and cooling rates, internal stresses exceeding the elastic limit of the metal are set up in the specimen. These cause localized plastic deformation which, when repeated many times, may cause weakening of the crystal lattice and formation and growth of micro-cracks. If, as a result of the formation of such micro-cracks, a grain has been divided into separate micro-volumes, the temperature gradient-induced stresses and the localized deformation in each of these micro-volumes will be considerably lower than those in an undamaged grain. Consequently, the number of thermal cycles necessary to form micro-cracks in these micro-volumes will be correspondingly higher. All the preliminary processes determining the orientation of irreversible dimensional changes take place during the first stage of thermal cycling, which is characterized by a fast rate of plastic deformation. At the end of this period, the formation of individual micro-cracks assumes the character of an "avalanche", whereby the rate of oriented deformation decreases,
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marking the transition from the first to the second period, similar considerations applying to the transition from the second to the third stage of the process. With decreasing amplitude of thermal cycling (i.e. with decreasing temperature gradient in the test piece), the transition from one stage to the next becomes delayed. The presence of the micro-cracks in the thermally cycled iron and nickel specimens has been confirmed by metallographic examination, and a large portion of the paper is concerned with a rather involved discussion of the changes in the microstructure of the nickel and iron specimens due to thermal cycling. The part played by the microcracks in determining the magnitude of oriented deformation of thermally cycled metals was best demonstrated by experiments conducted on aluminium. The results are reproduced in Fig.6, which shows the increase (mm) in length of aluminium specimens plotted against the number of cycles (20 - 500 - 20 °C), the unshaded and shaded blocks relating to test pieces heated in the water vapour and in air, respectively. It will be seen that the increase in length due to thermal cycling in water was considerably higher than that obtained in air. This effect is explained in the following manner. If the intra-granular cracks

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are formed already in the early stages of thermal cycling, bridging of these cracks by foreign atoms should markedly affect the rate of dimensional changes of the test pieces, since in this case plastic deformation will be readily transmitted from one microvolume to another, thereby increasing the probability of the onset of localized plastic deformation. If, however, the cracks remain "unbridged", they constitute regions where the stresses can, so to speak, be discharged, thus reducing the probability of localized plastic deformation and formation of new microcracks. When the aluminium specimens were heated in water, even thin cracks could be readily filled because atomic oxygen took part in the oxydizing reaction, whose effect on the rate of increase in length of the specimens became consequently apparent already in the early stages of the process. When air was used as the heating medium, it was only relatively wide cracks that could be filled by the products of oxydation, since in this case molecular oxygen took part in the reaction; consequently the effect of oxydation (increased rate of oriented deformation) did not become noticeable until the later stages of the process. The effect of the presence or absence of X

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microcracks on the rate of oriented deformation was also illustrated by experiments conducted on test pieces which had been preliminarily cold-rolled to various degrees of deformation. The results are reproduced in Fig.7, where the increase (%) in length of aluminium specimens thermally cycled in water vapour is plotted against the number of cycles, the degree of the preliminary deformation being given by each curve. It will be seen that, as the degree of preliminary cold-working increased (thus decreasing the number of micropores and other defects in the cast metal), the rate of oriented deformation due to thermal cycling decreased. The specimens, cold-rolled to 5% reduction in thickness, were an exception. This was explained by the fact that this degree of cold-rolling was too low to heal the internal defects in the metal but sufficiently high to change the shape in a manner likely to increase the probability of the formation of internal microcracks caused by local stress concentration.
There are 7 figures and 23 Soviet references.

ASSOCIATION: Institut avtomatiki i mekhaniki AN Latviyskoy SSR (Institute of Automation and Mechanics, AS, Latvian SSR).

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B103/B208

18 8300 2808

AUTHORS: Prosvirin, V. I. and Nesgovorov, L. Ya.

TITLE: Destruction due to corrosion of heated iron in a cold air stream of high velocities

PERIODICAL: Doklady Akademii nauk SSSR, v. 138, no. 3, 1961, 628-630

TEXT: The authors studied the interaction of heated iron with a cold air stream of a velocity of several tenthousand m/sec, giving rise to a destruction due to corrosion and erosion. A device (Fig. 1) was used consisting of an aerodynamic supersonic tube of the balloon-type with a closed working part and a free jet, as well as of an electric heating system. A _⌈‾⌉_-shaped sample was heated electrically to 800-1000°C. The velocity of the air flow was: 0; 0.3; 0.8; 1.7; 2.1; 3.0 of the number M which is 298 m/sec at M = 1. The air jet acted upon the sample for 10 - 120 sec. The total loss in weight of the sample was determined after having removed the cinder left on it by a special reagent. The destruction of the sample was only referred to a disk of 5 mm diameter that has been

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punched out from the central part of the sample after the experiment. Fig. 2 shows the rate of the corrosion caused by the gas at 800, 900, and 1000°C, as a function of the air velocity. To estimate approximately the effect of the number M of the jet on the destruction rate of iron, the authors used the following mean characteristics of the air jet: G_{sec} (kg/sec) = mean weight consumption of air in the working cross section, E_{kin} (kgm/sec) = mean flow of kinetic energy through a surface unit. G_{sec} determines the velocity of the oxygen atoms and, consequently, the possible velocity of cinder formation; E_{kin} characterizes the molecular-abrasive wear of cinder. Fig. 3 presents the results. It may be concluded from the curves of Fig. 2 that the destruction rate increases with increasing G_{sec} and E_{kin} in the range of M = 0 to M = 0.8. The effect of the flow rate on the destruction increases with rising temperature. This may be seen from the increasing angle of inclination of the ascending sections of the curve in the near-sonic range. The transition from near-sonic to supersonic velocities was not studied. The character of the

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flowing around is changed in the case of supersonic velocities by the appearance of the jump of compression in front of the sample. This causes a slower destruction of the sample on the change from M = 0.8 to M = 1.7 to 1.8 both by the decrease of the weight consumption of the air for M > 1 (Fig. 3) and also by the reduction of the kinetic energy behind the jump. Irrespective of the fact that the total supply of kinetic energy of the flow further increases with M > 1, the part of kinetic energy acting upon the sample decreases owing to its considerable losses on the compression jump. On further acceleration of the flow (M > 2) this part of kinetic energy will increase again and may thus compensate the continuous reduction of weight consumption. Hence the destruction rate may be somewhat increased by the total effect of these factors, which is the case if M > 2. In this range destruction is less affected by the flow rate than in the near-sonic range. The destruction is retarded by prolonging the time of the experiment for all values of the M-number. This indicates the corrosion-like character of the process. The tinder becomes thicker with prolonged oxidation, and, accordingly, the diffusion of reagents through the tinder takes more time. Since such a diffusion constitutes the slowest stage of the process, the entire oxidation process is thus inhibited.

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There are 3 figures and 8 references: 4 Soviet-bloc and 4 non-Soviet-bloc. The reference to English-language publication reads as follows: Ref. 3: D. Murphy, W. Wood, W. Jominy. Trans. Am. Soc. Steel Treat., 19, 193 (1931).

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18.7530 1087, 1454, 1145

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E071/E435

AUTHORS: Prosvirin, V.I. and Tarasov, B.Ya. (Riga)

TITLE: Rapid Nitration of Steels on Heating With High Frequency Currents

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Metallurgiya i toplivo, 1961, No.2, pp.132-140

TEXT: In view of the automation of technological processes it would be very advantageous to combine surface hardening with high frequency currents with simultaneous nitration. For this reason the authors carried out some investigations which showed that the diffusion saturation of the surface of pure iron during induction heating can be effected in a very short time corresponding to the duration of heating during surface hardening. Usually, with increasing nitration temperature, a sharp increase in the degree of dissociation of ammonia takes place which weakens the diffusion activity of the medium and leads to decarburization of the surface layer. It was, therefore, necessary to supply to the surface of the heated metal non-dissociated ammonia, so that the dissociation took place on the surface of the metal. For this purpose apparatus was designed (Fig.1) in which cold ammonia could be

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supplied to the specimen. The velocity of ammonia in respect of the surface of ammonia could be varied from 0 to 150 m/min (the velocity is referred to undissociated ammonia at 20°C). During the experiments the consumption of ammonia and the temperature of the surface of the specimen were recorded. After reaching the necessary temperature the specimen was cooled in cold water, the surface of which was covered with a thin layer of kerosene. The specimen tested was a hollow armco iron cylinder 55 mm high and 16 mm in diameter. It was placed on to a cylindrical holder of the same height. The distance between the specimen and the silica tube through which ammonia was passed was 1 to 1.5 mm. The amount of absorbed nitrogen was determined by the increase in weight of the specimen tested. The distribution of nitrogen along the depth of the diffusion layer was determined by chemical analysis of dissolved layers. The microhardness of the individual phases of the diffusion layer was determined on a ПМТ-3 (PMT-3) apparatus at a load of 10 g. The supply of ammonia to the specimen coincided with the switching on of the generator. The whole period of heating the specimen to a given temperature was included into the duration of the nitration process. It is pointed out that about 25% of the total duration of heating is used for heating the surface of the specimen to 500 to 550°C. Nitration was done in the temperature range 775 to 1100°C with the duration of heating to a given temperature not exceeding 5 min. The influence of the maximum heating temperature during nitration and of the velocity of ammonia on the absorption of nitrogen was studied using a heating period of 2 min. The influence of the maximum heating temperature (at optimum flow rates of ammonia) is shown in Fig.2. With increasing temperature, the activity of the gaseous medium increases passing through a maximum. Within the temperature range 800 to 900°C, the absorption of nitrogen by the surface remains approximately constant. The position of the maximum is determined by the velocity of ammonia. The influence of the velocity of ammonia on the activity of the medium at a constant temperature is shown in Fig.3a. For a given temperature there is an optimum velocity at which a maximum of the activity is obtained, beyond this velocity the activity of the medium decreases sharply. The influence of the ammonia velocity on its degree of dissociation is shown in Fig.3b. There was a minimum

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degree of dissociation for each temperature which changes little on further increase of the flow rate of ammonia. Structural analysis of the diffusion layers indicated that at all heating temperatures (775 to 910°C) and at various durations of the process, the diffusion layer consisted of two sharply expressed zones, separated from each other and from the base metal by boundaries parallel to the surface of the specimen. The external zone consisted of acicular crystallites corresponding to supercooled ξ-phase and high nitrogen concentrations. The second zone corresponded to nitrided austenite and nitrided martensite (solid solutions of nitrogen in γ and α iron). Further in depth, supersaturated nitrided ferrite is located. Photographs of the microstructure of diffusion layers are reproduced in the paper. The microhardness of the diffusion layers was measured on the external and internal boundary of each zone. The results are shown in Fig.5. The hardness of the first and the second zone of each nitration temperature (775 to 910°C) increases in the direction of the diffusion of nitrogen and the hardness of nitrided ferrite decreases. The dependence of the

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thickness of the diffusion layer (1st and 2nd zones) depends on the heating temperature, duration of heating and velocity of ammonia (Fig.6). With increasing velocity the thickness of the layer at first increases, achieves a maximum (within a range of 15 to 20 m/min) and then continuously decreases. With increasing temperature (at a constant heating time of 2 min) the thickness of the zone increases. The duration of heating to the maximum heating temperature has a substantial effect on the thickness of the diffusion layer. For instance, on heating to 800°C in 22 sec the thickness was about 0.015 mm, in 56 sec - 0.023 mm, in 2 min - 0.035 mm and in 5 min - 0.055 mm. Thereby the development of the zone with ξ-phase is much faster than that of the austenite-martensite zone. Since in all cases rapid cooling was used, the structures of the diffusion layer studied relate to supercooled phases. The external zone of the layer, pertaining to the ξ-phase, consisted of acicular crystallites inside which were occasional inclusions, more often along the boundaries. The austenite-martensite zone closer to the external surface was more uniform and apparently rich in γ-phase. The internal part of this zone has a sorbitic structure, occasionally with a directional

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orientation, similar to martensite in steels. The third zone of the diffusion layer - supercooled nitrided ferrite - had a large thickness reaching up to 0.5 mm in 2 min of nitration. In the grains of this zone, at the martensite boundary, nitride inclusions were observed; these were often orientated along the slip planes. The microhardness of these grains is by 20 to 25 units above that of ferrite containing nitrogen. Since the appearance of ξ-phase in the surface layer would not always be desirable, the authors established that its appearance can be avoided by increasing the temperature to 1020°C. Although on increasing the temperature from 910 to 1020°C the diffusion activity of the medium decreases by about 25%, yet the amount of absorbed nitrogen is sufficient to cause structural changes in the diffusion layer. The data obtained indicate that the velocity of ammonia at 1020°C has little influence on the absorption of nitrogen by iron. Within a range of velocities 6 to 40 m/min, the specific absorption of nitrogen in 2 min amounts to about 1.2×10^{-3} g/cm^2. The microstructure of the diffusion layer consists of a martensite zone of needle-like structure (Fig.4). The thickness

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of the martensite zone reaches 1 mm and depends little on the consumption of ammonia. The velocity of the diffusion of nitrogen is so high that the nitrogen concentration corresponding to the appearance of the ξ-phase is not reached. On nitration at a higher temperature (1100°C) the necessary concentration of nitrogen in the diffusion layer could not be achieved. An interesting feature in the dispersion hardening was observed on low temperature heating (175°C for 30 min) of nitrided specimens. Microhardness measurements were carried out before and after heating (table). The low temperature heating could cause strengthening or weakening of nitrided phases depending on the time of separation of secondary phases - during the low temperature heating or during cooling on hardening. Such behaviour of the ξ-phase and nitrided austenite was actually observed. Nitrided martensite appears to undergo a considerable decomposition during low temperature heating. The following conclusions are arrived at: 1) The possibility was demonstrated of rapid nitriding during high frequency heating for hardening, permitting the formation of high concentrations of nitrogen and a considerable depth of the diffusion layer in a few seconds to

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1 - 2 minutes. 2) The diffusion layers formed contain the following phases: a) nitrided ξ-phase in the supercooled state, this possesses a high hardness (400 kg/mm^2) and is capable of weak dispersion hardening, it reacts strongly to changes in the velocity of flow of ammonia and the duration of heating during nitration and depends little on the temperature within the range of 775 to 910°C; b) nitrided supercooled austenite has a low hardness (200 kg/mm^2) and a higher tendency to dispersion hardening than the ξ-phase; c) nitrided martensite possesses the highest hardness (600 to 700 kg/mm^2), the thickness of the layer and the hardness increase with increasing heating temperature up to 910°C; d) nitrided ferrite has a maximum thickness reaching 0.5 mm in 2 minutes of nitriding. 3) To each heating temperature there is a corresponding minimum degree of dissociation of ammonia, determined by the equilibrium between the components of the gaseous mixture. This equilibrium appears at high velocities of the gas, when the completion of the association of atoms of hydrogen and nitrogen into their molecules does not take place. There are 6 figures, 1 table and